A1250-1

Top 100 chemical producers
Page 27

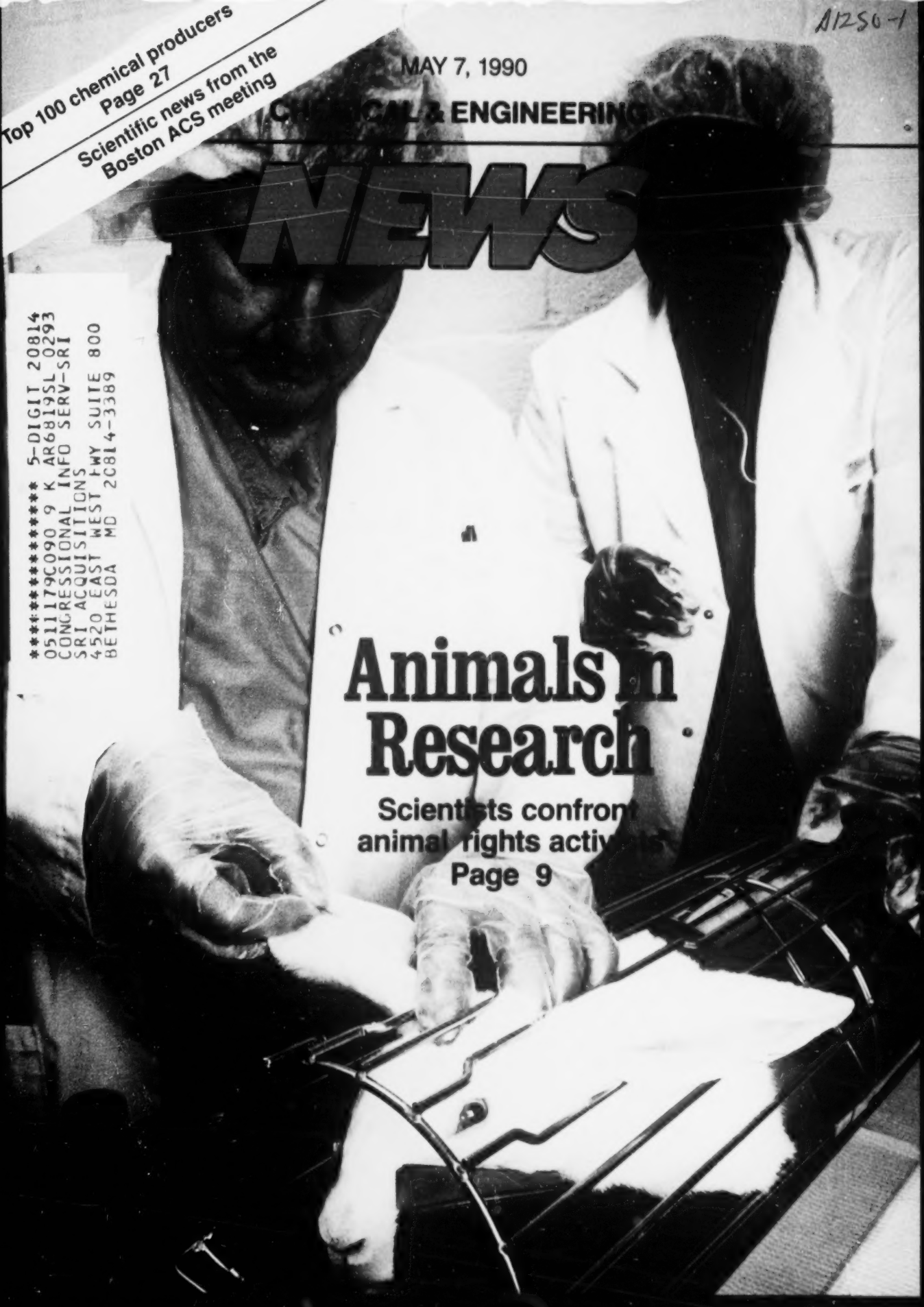
Scientific news from the
Boston ACS meeting

MAY 7, 1990

C[illegible]CAL & ENGINEERING

NEWS

********** 5-DIGIT 20814
05111790090 9 K AR6819SL 0293
CONGRESSIONAL INFO SERV-SRI
SRI ACQUISITIONS
4520 EAST WEST HWY SUITE 800
BETHESDA MD 20814-3389



Animals in Research

Scientists confront animal rights activists

Page 9

CHEMICAL & ENGINEERING
NEWS
MAY 7, 1990

Volume 68, Number 19
CENEAR 68 (19) 1–84
ISSN 0009-2347

News of the Week

■ **Scientific review panel endorses National Toxicology Program's findings on sodium fluoride that suggest equivocal evidence for carcinogenicity in male rats.** Page 4

■ **California's environmental initiative, dubbed "Big Green," gets more than enough signatures to place it on November ballot.** Page 5

■ **EPA is developing regulations that would further limit dioxin levels in paper products.** Page 5

■ **Academic research funding system overburdened and not organizationally equipped for the 1990s, says study by Congressional group.** Page 6

■ **Gene-engineered bovine growth hormone becomes first such product banned in U.S.** Page 6

Cover: Photo courtesy of National Institutes of Health

Letters 2

Concentrates

Business 25
Government 41
Science/Technology 50

The Departments

New Products 49
Meeting Briefs 62
Awards 69
Newscripts 84

Business

Combined sales of the 100 largest U.S. chemical producers set another record in 1989, up 6% from the previous year to $181 billion. **Page 27**

Outlook for biotechnology industry is bright, industry leaders told a symposium at the ACS national meeting in Boston. **Page 39**

Government

National recycling program to prevent emission of CFCs into the atmosphere is being proposed by EPA. **Page 44**

U.S. firms are being helped to develop a global environment management initiative by former EPA Administrator Lee M. Thomas. **Page 45**

Science/Technology

From the Boston meeting: Alternate theories of conductivity in nonconjugated polymers debated; GE develops new methods to make resins from cyclic oligomers; *C*-alkylation effective in solubilizing coals; Monsanto uses chiral catalyst to synthesize arthritis drug naproxen; alternatives to thermal cracking of higher hydrocarbons for ethylene probed; new class of synthetic lubricants for extreme service conditions developed. **Page 53**

Books

"The American Synthetic Rubber Research Program" traces U.S. government's World War II efforts to boost rubber production. **Page 64**

ACS News

The national meeting in Boston offered participants a variety of activities, captured on film by C&EN's roving photographer. **Page 66**

News Focus

Biomedical and behavioral researchers are mounting efforts to counter animal rights groups whose antivivisection activities have included criticism of scientists and attacks on labs. **Page 9**

Chemical & Engineering News
1155—16th St., N.W., Washington, D.C. 20036
Editor: Michael Heylin
Assistant Managing Editors: David M. Kiefer, James H. Krieger, Janice R. Long, Donald J. Soisson, William J. Storck. **News Editor:** Wilbert C. Lepkowski
Staff Editor: Ernest L. Carpenter
Senior Editors: New York: Earl V. Anderson, Stephen C. Stinson; Chicago: Joseph Haggin; London: Patricia L. Layman; Washington: Doron Dagani, Lois R. Ember, Bette Hileman, Rebecca L. Rawls, Pamela S. Zurer
Associate Editors: Stuart A. Borman, Mairin B. Brennan, Ann Marie Menting, Richard J. Seltzer
Service Departments Editor: Dolores Miner
Editing Services: Anne Riesberg (Head), Arlene Goldberg-Gist (Editorial Assistant), Patricia Oates (Administrative Assistant)
News Bureaus: Northeast News Bureau: (201) 906-8300 Marc S. Reisch (Associate Editor), Ann M. Thayer (Associate Editor), Rachel Eskenazi (Administrative Assistant). Chicago: (708) 256-4143 Ward Worthy (Head). Houston: (713) 973-8161 Bruce F. Greek (Head), Susan J. Ainsworth, (Associate Editor). Washington: (202) 872-4495 David J. Hanson (Head). West Coast: (415) 653-3630 Rudy M. Baum (Head). **Foreign Bureau:** London: (01) 540-0414 Dermot A. O'Sullivan (Head)
Graphics and Production: Leroy Corcoran (Head), Alan Kahan (Art Director), Barbara Fryer (Production/Art Director), Linda Mattingly (Staff Artist), Diane Kelly (Costing)
Business Manager: Arthur Poulos
Circulation Development: Claud K. Robinson
ADVISORY BOARD: Dexter F. Baker, George M. Bodner, Will D. Carpenter, Renée G. Ford, Ethan C. Galloway, Louis J. Glunz, Harry S. Hertz, Christopher T. Hill, Kendall N. Houk, Cynthia A. Maryanoff, Linda B. McGown, C. Bradley Moore, Koji Nakanishi, George B. Rathmann, David A. Shirley, Robert M. Simon, Peter H. Spitz, Barry M. Trost
Published by
AMERICAN CHEMICAL SOCIETY
(202) 872-4600; TDD (202) 872-8733
John K Crum, Executive Director
Robert H. Marks, Director, Publications Division
PUBLISHING BOARD: Jean'ne M. Shreeve *(Chairman); Board of Directors Chairman:* Joseph A. Dixon; *President:* Paul G. Gassman; Richard L. Deming; William P. Jencks; Gary J. Long; and Louis D. Quin

© Copyright 1990, American Chemical Society

Subscription & Member Record Service: Send all new and renewal subscriptions with payments to: Controller, ACS, P.O. Box 28597, Central Station, Washington, D.C. 20005. Correspondence and telephone calls for changes of address, claims for missing issues, subscription service, status of records and accounts should be directed to: Manager, Member & Subscriber Services, ACS, P.O. Box 3337, Columbus, Ohio 43210; (800) 333-9511 or (614) 447-3776.

For changes of address, include both old and new addresses with ZIP code numbers and mailing label from a recent issue. Allow four weeks for change to become effective. Claims for missing numbers will not be allowed if loss was due to failure of notice of change of address to be received in the time specified; if claim is dated (a) North America: more than 90 days beyond issue date, (b) all other foreign: more than one year beyond issue date; or if the reason given is "missing from files."

Subscription Rates 1990. Printed editions: nonmembers U.S. 1 yr. $60, 2 yr. $108, outside U.S. 1 yr. $93, 2 yr. $174. Air freight rates available on request. Rates above do not apply to nonmember subscribers in Japan, who must enter subscription orders with Maruzen Co. Ltd., 3-10 Nihonbashi 2-chome, Chuo-ku, Tokyo 103, Japan. Tel: (03) 272-7211. Single copies: Current $9.00. Rates for back issues and volumes are available from Microforms & Back Issues Office, ACS, 1155—16th St., N.W., Washington, D.C. 20036. Back and current issues available on microfilm and microfiche. Rates on request from Microform Program, ACS.

Chemical & Engineering News (ISSN 0009-2347) is published weekly except for the last week in December by the American Chemical Society at 1155—16th St., N.W., Washington, D.C. 20036. Second-class postage paid at Washington, D.C., and additional mailing offices. POSTMASTER: Send address changes to Chemical & Engineering News, Membership & Subscription Services, P.O. Box 3337, Columbus, Ohio 43210. ACS assumes no responsibility for the statements and opinions advanced by the contributors to its publications.

Advertising Management
CENTCOM LTD.
(For list of offices see page 83)

LETTERS

Apologies to Gerber

SIR: I write to correct a serious mistake I made in my Priestley Medal Address (C&EN, April 23, page 24). I incorrectly identified Gerber as involved in a baby food scandal. The intended reference was to Beech-Nut Nutrition Corp., which distributed as pure apple juice concoctions of sugars with little real apple juice. I sincerely apologize to Gerber for my mistake.

Roald Hoffmann
Professor
Cornell University

Chemical information systems

SIR: In regard to Stuart Kaback's letter (C&EN, Feb. 5, page 2), as a 10-plus year ACS member, I have been involved in chemical information for only six years, and have some thoughts in this area. It is widely believed that the availability of information is important to all sections of the chemical world. As a person whose job it is to provide comprehensive retrieval of a wide variety of chemical information, I know how to use at least seven different computer-based systems as tools. I have learned that each system has strengths and weaknesses. When the same data are available on multiple systems, the experienced searcher realizes that for different questions different systems are best. Often, answering a specific question is only possible using the strengths of one system. No one system is best for all types of questions.

Also, in my six short years in chemical information, I have seen tremendous change in both databases and host systems. This change has produced better databases and better host systems. It is notable that change comes fastest when there is competition of some sort. One database improves its indexing of polymers, then another starts to improve its polymer indexing. One system allows graphical input of chemical structures for searching, then another develops a similar system. The list is endless. This is very good for people who need chemical information. More tools are available to allow them to answer whatever kinds of questions they have.

To the specific point of CAS's licensing policies and income: Any chemical information user's worst nightmare is an insolvent CAS decreasing its level of service, or quitting altogether. We all want CAS to get the money it needs to continue. The fairness of using CAS to produce income to fund other ACS programs is doubtful to many, and certainly should never be a major goal of the program. CAS's purpose is to provide chemical information to the chemical community. Having *CA*'s abstracts and structure data available on as many host systems as possible improves access to this information.

CAS's pricing policies are a separate matter. CAS must be able to charge whatever is needed to keep CAS operational with a high level of performance. However, keeping STN usage high by maintaining such important data exclusively does not provide good service to the information world, nor does it provoke the completion [*sic*] needed to induce improvements needed to keep STN viable in the long term. STN is a very good system. If allowed to stand on its own, people would use it for its flexibility and ability to answer their questions.

If CAS makes its data available as widely as possible, this will only increase its true customer base. I wish CAS long life and success, but I want it to provide chemical information to a wide audience, thus helping the chemical world as a whole.

Jerri J. Chase
Dow Chemical Patent Department, Midland, Mich.

Training more chemists

SIR: Amidst all the concern about training more chemists I would like to ask, "Why?" I see no shortage of chemists—particularly Ph.D.s. Quite the contrary, I see people leaving science for better career opportunities elsewhere. Shortages, where they occur, result from the very specific experience requirements that today's employers often make.

Do we, then, need to train more chemists to meet the challenges of tomorrow? Perhaps. There certainly are a lot of problems that need to be solved. I hope that someday government and industry will recognize that they must employ more scientists in order to solve these problems. But I wouldn't advise anyone to gamble his or her career on that happening soon. Wouldn't we all be better off if ACS spent more time pro-

Correction

• April 2, page 25: Stuart M. Kaback, not Kabak, was recently promoted at Exxon Research & Engineering Co.

Top 100 Chemical Producers Post Another Record Sales Year

Combined sales of 100 largest firms totaled $181 billion last year, up 6% from 1988; sales fell for 25, however, compared with five in previous year

William J. Storck,
C&EN Northeast News Bureau

Although 1989 was a year in which chemical industry growth slowed, thanks to the first half, it still produced records in the volume of business done by producers of chemical products.

This is reflected in the results for the companies listed in C&EN's annual ranking of the Top 100 chemical producers. However, as in past years, restructuring of the industry has brought changes to the companies listed and in the relative rankings of the producers.

For 1989, sales of chemicals on a dollar basis for the 100 companies rose 6% from sales of the 100 firms ranked for 1988, reaching a total of slightly more than $181 billion. This represents more than 70% of the government's estimates of shipments of chemicals and allied products last year. And, if drugs are excluded as C&EN does for its rankings, the Top 100 companies accounted for almost 85% of U.S. chemical shipments.

However, in spite of the increase in sales for the total group of companies, 25 of the firms recorded sales declines for the year. This is up considerably from the 1988 ranking, when only five had sales declines.

The mix of companies making up the chemical sales figures in 1989 remained fairly constant with the previous year. The 50 largest companies continue to dominate, providing 86% of the total sales dollars. This is the same percentage as in the ranking for 1988.

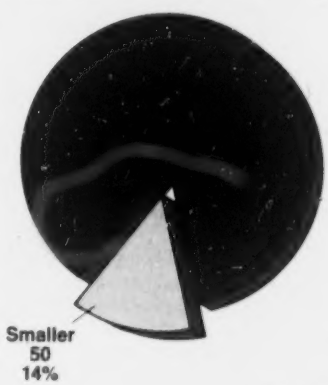
Firms classified as chemical companies also continue to have the biggest share of the sales total. These firms accounted for 41% of the total in 1989. This was followed by diversified companies with 21% of total sales in 1989, down from 24% in 1988. Petroleum and gas companies contributed 23% of the total, up from 20% for the 1988 ranking. And U.S. subsidiaries of foreign firms had a 15% share, up from 14% in the previous year.

Eight companies are new to the list for 1989, but in most instances they represent companies that were previously on the list and have been spun off, as in the case of Lyondell Petrochemical replacing its former parent, Atlantic Richfield. Or they are U.S. firms that have been acquired, with the new parent now listed—an example is Pennwalt being replaced by Atochem.

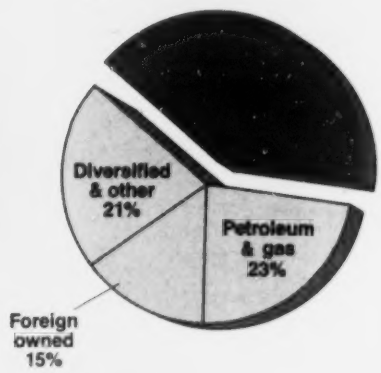
Other companies new to the Top 100 include Tenneco, which has made its chemical sales figures easier to obtain. Degussa and Nova Corp. are two foreign-owned firms now divulging U.S. chemical sales. Eagle-Picher and Nu-West, which acquired the former Beker Industries fertilizer operations a few years ago, have had chemical growth sufficient to bring them into the Top 100 producers.

Atlas Powder, the remaining company new to the rankings for 1989, is in reality a company in limbo. It is currently owned by Tyler Corp., now off the list. Because of the pending sale of Atlas to ICI, Tyler is carrying Atlas separately in its annual report. Besides Atlantic Richfield, Pennwalt, and Tyler, the other companies not on the list for 1989 are Eli Lilly, which has assigned its agricultural chemicals to a joint venture with Dow Chemical and no longer reports chemical sales; Himont, now wholly owned by Italy's

Larger companies heavily dominate chemical sales...



... and chemical firms have biggest portion of sales



1989 sales = $181 billion

Note: Based on chemical sales figures for Top 100 producers in 1989.

Chemical sales, operating profits increased for most producers

Rank 1989	Rank 1988		Chemical sales 1989 ($ millions)	Change from 1988	Chemical sales as % of total sales	Industry classification	Chemical operating profits[a] ($ millions)	Change from 1988	Chemical operating profits as % of total profits	Operating profit margin[b]	Identifiable chemical assets ($ millions)	Chemical assets as % of total assets	Operating return on chemical assets[c]
1	1	Du Pont	$15,249	3.6%	42.9%	Diversified	$2769	8.0%	57.0%	18.2%	$12,514	36.0%	22.1%
2	2	Dow Chemical	14,179	4.0	80.6	Basic chemicals	3543	−2.5	88.4	25.0	12,202	55.0	29.0
3	3	Exxon	10,559	5.7	11.1	Petroleum	1609	−13.6	19.2	15.2	7,118	8.6	22.6
4	4	Union Carbide	7,962[d]	4.7	91.1	Basic chemicals	1221	−20.6	96.5	15.4	6,172	72.2	19.8
5	5	Monsanto	5,782	4.5	66.6	Basic chemicals	929	2.1	86.2	16.1	4,482	52.1	20.7
6	6	Hoechst Celanese	5,658	5.4	94.0	Basic chemicals	576	2.3	114.7	10.2	na	na	na
7	7	Occidental Petroleum	5,203	11.3	25.9	Petroleum	1235	17.6	280.0	23.7	5,508	26.6	22.4
8	12	General Electric	4,929[d]	39.3	9.0	Diversified	1057	44.2	15.5	21.4	8,023	6.3	13.2
9	8	BASF	4,461	6.0	82.3	Basic chemicals	na	na	na	na	na	na	na
10	9	Amoco	4,274	−1.8	17.8	Petroleum	744	−27.2	21.6	17.4	3,158	10.4	23.6
11	10	Mobil	4,039	−5.6	7.3	Petroleum	774	−9.0	16.8	19.2	2,702	6.9	28.6
12	11	Shell Oil	3,833	−4.3	16.2	Petroleum	941	26.1	37.9	24.5	3,824	13.9	24.6
13	15	Eastman Kodak	3,522	16.1	19.1	Photo equipment	643	2.4	40.4	18.3	3,238	13.7	19.9
14	13	Chevron	3,328	3.9	10.4	Petroleum	532	−13.6	29.5	16.0	2,476	7.3	21.5
15	14	W. R. Grace	3,256	4.0	53.2	Specialty chemicals	406	4.6	66.0	12.5	2,436	43.4	16.7
16	16	Allied-Signal	2,993	−1.3	25.1	Diversified	355	−5.8	37.5	11.9	1,879	18.5	18.9
17	17	Arco Chemical	2,663	−1.4	100.0	Basic chemicals	580	−19.7	100.0	21.8	2,655	100.0	21.8
18	18	Rohm & Haas	2,661	5.0	100.0	Basic chemicals	287	−23.9	100.0	10.8	2,128	86.7	13.5
19	20	Air Products[e]	2,481	10.9	93.9	Basic chemicals	425	3.8	109.5	17.1	2,835	84.2	15.0
20	19	Phillips Petroleum	2,449	−2.7	19.8	Petroleum	652	−28.4	46.9	26.6	1,377	12.2	47.3
21	23	Bayer USA	2,300	7.5	42.4	Diversified chemicals	127[f]	7.8	82.5	5.5	na	na	na
22	22	American Cyanamid	2,241	3.4	46.4	Basic chemicals	236	10.0	40.7	10.5	1,779	35.8	13.2
23	24	Ashland Oil[e]	2,230	6.7	26.3	Petroleum	98	−3.9	34.8	4.4	744	16.7	13.2
24	21	Quantum Chemical	2,015	−9.2	75.4	Basic chemicals	423	−40.5	89.0	21.0	1,830	60.9	23.1
25	25	B. F. Goodrich	1,977	−4.7	61.7	Basic chemicals	261	−15.4	95.0	13.2	1,467	64.5	17.8
26	—	Lyondell Petrochemical	1,905	0.1	35.6	Petroleum	na	na	na	na	na	na	na
27	28	Texaco	1,818	6.3	5.6	Petroleum	399	5.3	11.6	21.9	1,126	4.4	35.4
28	—	Alochem	1,778	206.0	100.0	Basic chemicals	na	na	na	na	na	na	na
29	38	Aluminum Co. of America	1,700	39.9	15.6	Nonferrous metals	na	na	na	na	2,500	21.7	0
30	27	Hercules	1,632	−4.2	52.8	Basic chemicals	126	−0.8	62.5	7.7	1,294	35.4	9.7
31	37	Akzo	1,612	19.7	100.0	Basic chemicals	117	54.4	100.0	7.3	na	na	na
32	35	Rhône-Poulenc	1,600	14.3	100.0	Specialty chemicals	na	na	na	na	na	na	na
33	32	Dow Corning	1,575	6.6	100.0	Specialty chemicals	163[f]	8.2	100.0	10.3	na	na	na
34	34	National Starch	1,569	10.9	100.0	Specialty chemicals	226	13.2	100.0	14.4	1,269	100.0	17.8
35	33	FMC	1,542	7.4	43.1	Machinery	220	−1.5	55.5	14.3	1,329	47.1	16.6
36	30	Ethyl	1,520	−9.2	62.5	Basic chemicals	283	−8.5	69.4	18.6	1,055	18.7	26.8
37	31	BP America	1,426	−5.4	6.1	Petroleum	68	−34.6	3.3	4.8	na	na	na
38	36	Olin	1,285	−5.9	51.2	Basic chemicals	174	65.7	76.7	13.5	936	49.2	18.6
39	39	Unocal	1,276	6.0	11.6	Petroleum	74	−59.3	12.8	5.8	622	6.7	11.9
40	—	Tenneco	1,224	0.5	8.7	Petroleum	119	−1.7	8.5	9.7	1,229	7.2	9.7
41	44	IMC Fertilizer[e]	1,222	12.5	100.0	Agrochemicals	257	17.7	100.0	21.1	1,678	100.0	15.3
42	40	Huntsman Chemical	1,200	0	100.0	Basic chemicals	na	na	na	na	na	na	na
42	43	Ciba-Geigy	1,200[h]	9.3	34.3	Specialty chemicals	na	na	na	na	na	na	na
44	42	PPG Industries	1,175	5.6	20.5	Glass products	257	0.8	35.2	21.9	1,033	18.3	24.9
45	47	Lubrizol	1,124	8.5	92.1	Specialty chemicals	321	4.8	90.2	28.5	733	76.3	43.8
46	41	Freeport-McMoRan	1,105	−2.3	95.6	Agrochemicals	108	−45.3	82.1	9.8	876	72.2	12.3
46	46	Georgia Gulf	1,105	4.1	100.0	Basic chemicals	300	−3.9	100.0	27.2	473	100.0	63.4
48	51	Nalco Chemical	1,071	7.7	100.0	Specialty chemicals	181	14.1	100.0	16.9	939	100.0	19.3
49	49	NL Industries	1,001	−0.6	100.0	Basic chemicals	278	6.5	100.0	27.8	na	na	na
50	50	Solvay America	1,000[d]	0	100.0	Basic chemicals	na	na	na	na	na	na	na

Rank 1989	Rank 1988		Chemical sales 1989 ($ millions)	Change from 1988	Chemical sales as % of total sales	Industry classification	Chemical operating profits[a] ($ millions)	Change from 1988	Chemical operating profits as % of total profits	Operating profit margin[b]	Identifiable chemical assets ($ millions)	Chemical assets as % of total assets	Operating return on chemical assets[c]
51	45	Aristech	$996	−6.5%	100.0%	Basic chemicals	$140	−28.9%	100.0%	14.0%	$721	100.0%	19.4%
52	54	Cabot[e]	951	5.2	49.1	Basic chemicals	112	−31.8	176.7	11.7	790	55.7	14.1
53	56	Terra Chemicals	949	11.9	100.0	Agrochemicals	na	na	na	na	na	na	na
54	55	Morton International[d]	935	7.0	66.5	Diversified	144	−3.0	69.6	15.4	861	63.1	16.8
55	60	Farmland Industries[f]	903	17.7	30.3	Agricultural supplies	90	20.3	50.6	10.0	382	32.3	23.6
56	—	Degussa	886	na	51.4	Natural gas	na	na	na	na	na	na	na
57	57	International Flavors	870	3.8	100.0	Specialty chemicals	223	6.6	100.0	25.7	684	70.6	32.6
58	52	CF Industries	856	−10.6	100.0	Agrochemicals	27	−75.1	100.0	3.2	798	100.0	3.4
59	63	Engelhard	813	11.9	33.8	Specialty metals	96	−10.3	79.0	11.8	888	66.3	10.8
60	62	Uniroyal Chemical	805	9.6	100.0	Specialty chemicals	na	na	na	na	na	na	na
61	68	Great Lakes Chemical	792	42.0	100.0	Specialty chemicals	202	40.6	100.0	25.5	1,097	100.0	18.4
62	59	Vista Chemicals[e]	779	−0.3	100.0	Basic chemicals	227	16.8	100.0	29.2	567	100.0	40.1
63	—	Nova	778	44.3	100.0	Basic chemicals	na	na	na	na	na	na	na
64	61	Witco	766[h]	1.0	48.2	Specialty chemicals	18	−71.4	24.2	2.3	377	33.1	4.7
65	65	H. B. Fuller[j]	753	10.0	100.0	Specialty chemicals	46	−0.9	100.0	6.1	455	100.0	10.1
66	66	American Petrofina	662	−2.9	21.8	Petroleum	138	−50.7	69.4	20.9	435	17.3	31.9
67	53	International Minerals[g]	640	−31.3	65.1	Agrochemicals	50	−57.4	37.7	7.8	673	34.1	7.4
68	70	GAF	600	10.1	59.4	Specialty chemicals	171	13.9	93.9	28.5	na	na	na
69	71	Kerr-McGee	592	14.3	19.2	Petroleum	125	22.5	40.7	21.1	794	23.8	15.7
70	64	Sterling Chemical[e]	581	−16.9	100.0	Basic chemicals	156	−49.9	100.0	26.9	329	100.0	47.5
71	—	Atlas Powder	543	11.9	100.0	Explosives	na	na	na	na	na	na	na
72	77	Betz Laboratories	517	15.4	100.0	Specialty chemicals	88	15.1	100.0	16.9	369	100.0	23.7
73	75	Sun Co.	510	10.6	4.6	Petroleum	na	na	na	na	na	na	na
74	72	Pfizer	509	−0.6	9.0	Drugs	39	−20.2	4.1	7.7	538	6.5	7.2
75	76	Hoffmann-La Roche	500[k]	11.1	22.7	Drugs	na	na	na	na	na	na	na
76	74	Merck	492	5.6	7.5	Drugs	59	−3.6	2.7	12.0	470	7.0	12.6
77	78	Ferro	478	7.8	44.1	Specialty materials	17	−6.0	18.2	3.6	251	37.5	6.8
78	69	Borden Chemicals	466	−15.7	100.0	Dairy products	95	−39.0	99.7	20.4	550	100.0	17.3
79	80	Loctite[g]	457	9.5	100.0	Specialty chemicals	80	21.1	100.0	17.5	362	100.0	22.0
80	82	Lonza	450	13.9	100.0	Specialty chemicals	na	na	na	na	na	na	na
81	79	Dexter	439	3.4	51.7	Rubber products	31	20.5	33.1	7.1	310	44.6	10.1
82	83	Vulcan Materials	430	12.5	40.0	Nonmetallic minerals	86	30.7	42.9	20.1	na	na	na
83	81	Union Camp	413	3.7	15.0	Diversified	14	−54.8	2.7	3.3	289	8.5	4.7
84	85	Sigma-Aldrich	359	18.9	81.4	Specialty chemicals	87	12.8	86.9	24.2	418	88.5	20.7
85	84	Stepan	348	4.0	100.0	Specialty chemicals	12	−43.1	100.0	3.4	215	100.0	5.4
86	89	First Mississippi[g]	308	29.5	70.9	Agrochemicals	27	16.0	82.3	8.7	166	34.7	16.2
87	90	Crompton & Knowles	281	20.9	79.0	Specialty chemicals	35	37.0	71.4	12.9	170	78.2	21.2
88	87	Chemed	277	2.7	52.3	Specialty chemicals	38	14.3	67.4	13.8	137	40.7	28.0
89	86	Petrolite[f]	275	0.2	94.3	Specialty chemicals	19	−12.3	217.6	6.7	191	79.6	9.7
90	91	Calgon Carbon	253	12.1	100.0	Basic chemicals	57	10.8	100.0	22.4	234	100.0	24.3
90	88	Georgia-Pacific	253	5.0	2.5	Wood products	na	na	na	na	na	na	na
92	93	Mississippi Chemical[g]	209	12.4	100.0	Farm cooperative	47	157.7	100.0	22.5	577	100.0	8.1
93	92	Sherex	188	−6.0	100.0	Specialty chemicals	na	na	na	na	na	na	na
94	94	Quaker Chemical	182	9.0	100.0	Specialty chemicals	23	32.5	100.0	12.7	109	83.3	21.0
95	95	LeaRonal[m]	157	0	100.0	Specialty chemicals	16	15.2	100.0	10.3	88	100.0	18.3
96	—	Nu-West[g]	155	176.3	100.0	Agrochemicals	−3	def	def	def	170	100.0	def
97	—	Eagle-Picher	152[d]	−21.3	20.9	Diversified	15	−35.1	36.9	9.7	86	17.8	17.3
98	96	Lawter International	136	8.1	100.0	Specialty chemicals	23	−17.8	100.0	16.5	134	100.0	16.8
99	99	Cambrex Corp.	131	8.9	100.0	Specialty chemicals	7	−48.6	100.0	5.0	129	100.0	5.1
100	98	Agway	118[k]	−4.3	3.7	Farm cooperative	na	na	na	na	na	na	na

a Operating income is sales less administrative expenses and cost of sales. b Chemical operating profit as a percentage of chemical sales. c Chemical operating profit as a percentage of identifiable chemical assets. d Chemical sales include significant amounts of nonchemical products. e Fiscal year ended Sept. 30. f Chemical net income. g Fiscal year ended June 30. h Does not include all chemical sales. i Fiscal year ended Aug. 31. j Fiscal year ended Nov. 30. k C&EN estimate. l Fiscal year ended Oct. 31. m Fiscal year ended Feb. 28, 1989.

C&EN's five-way ranking of the Top 100 chemical producers

$ Millions	Chemical sales	Rank		Chemical operating profits	Rank		Chemical operating profit margin	Rank		Identifiable chemical assets	Rank		Return on chemical assets	Rank	
	1989	1989	1988	1989	1989	1988	1989	1989	1988	1989	1989	1988	1989	1989	1988
Agway	$ 118	100	98	na	—	—	na	—	—	na	—	—	na	—	—
Air Products	2,481	19	20	$ 425	16	19	17.1%	32	35	$ 2,835	11	14	15.0%	49	52
Akzo	1,612	31	37	117	45	58	7.3	66	80	na	—	—	na	—	—
Allied	2,993	15	16	355	20	22	11.9	51	55	1,879	18	18	18.9	34	37
Aluminum Co. of America	1,700	29	38	na	—	18	na	—	4	2,500	14	12	na	—	53
American Cyanamid	2,241	22	22	236	29	34	10.5	55	65	1,779	20	19	13.2	52	60
American Petrofina	662	66	66	138	41	29	20.9	23	2	435	53	57	31.9	8	2
Amoco	4,274	10	9	744	10	6	17.4	31	17	3,158	10	9	23.6	17	10
Arco Chemical	2,663	17	17	580	13	12	21.8	18	11	2,655	13	13	21.8	24	17
Aristech	996	51	45	140	40	38	14.0	43	34	721	42	45	19.4	32	16
Ashland Oil	2,230	23	24	98	48	54	4.4	73	81	744	40	42	13.2	52	61
Atlas Powder	543	71	—	na	—	—	na	—	—	na	—	—	na	—	—
Atochem	1,778	28	—	na	—	—	na	—	—	na	—	—	na	—	—
BASF	4,461	9	8	na	—	—	na	—	—	na	—	—	na	—	—
BP America	1,426	37	31	68	57	—	4.8	72	—	na	—	—	na	—	—
Bayer USA	2,300	21	23	na	—	—	na	—	—	na	—	—	na	—	—
Betz Laboratories	517	72	77	88	52	—	16.9	33	—	369	57	—	23.7	16	—
Borden Chemicals	466	78	69	95	50	49	20.4	24	22	550	48	50	17.3	40	39
CF Industries	856	58	52	27	67	51	3.2	77	59	798	37	33	3.4	72	64
Cabot	951	52	54	112	46	41	11.7	53	36	790	39	47	14.1	50	24
Calgon Carbon	253	90	91	57	59	64	22.4	15	19	234	63	67	24.3	15	20
Cambrex Corp.	131	99	99	7	78	81	5.0	71	61	129	71	—	5.1	69	—
Chemed	277	88	87	38	64	68	13.8	44	57	137	69	72	28.0	11	22
Chevron	3,328	14	13	532	15	15	16.0	37	30	2,476	15	16	21.5	25	14
Ciba-Geigy	1,200	42	43	na	—	—	na	—	—	na	—	—	na	—	—
Crompton & Knowles	281	87	90	36	65	71	12.9	47	60	170	66	71	21.2	26	51
Degussa	886	56	—	na	—	—	na	—	—	na	—	—	na	—	—
Dexter	439	81	79	31	66	72	7.1	67	79	310	60	62	10.1	59	73
Dow Chemical	14,179	2	2	3543	1	1	25.0	10	7	12,202	2	1	29.0	9	11
Dow Corning	1,575	33	32	na	—	—	na	—	—	na	—	—	na	—	—
Du Pont	15,249	1	1	2769	2	2	18.2	29	37	12,514	1	2	22.1	22	21
Eagle-Picher	152	97	—	15	75	—	9.7	60	—	86	74	—	17.3	40	—
Eastman Kodak	3,522	13	15	643	12	14	18.3	28	25	3,238	9	10	19.9	30	35
Engelhard	813	59	63	96	49	52	11.8	52	50	888	34	37	10.8	58	62
Ethyl	1,520	36	30	283	24	26	18.6	27	33	1,055	30	26	26.8	12	19
Exxon	10,559	3	3	1609	3	3	15.2	40	31	7,118	4	5	22.6	20	18
FMC	1,542	35	33	220	33	32	14.3	42	46	1,329	24	25	16.6	45	47
Farmland Industries	903	55	60	90	51	59	10.0	58	68	382	55	59	23.6	17	38
Ferro	478	77	78	17	73	76	3.6	74	82	251	62	65	6.8	67	75
First Mississippi	308	86	89	27	67	73	8.7	62	67	166	68	75	16.2	46	31
Freeport-McMoRan	1,105	46	41	108	47	37	9.8	59	38	876	35	35	12.3	56	32
H. B. Fuller	753	65	65	46	62	66	6.1	69	77	455	52	55	10.1	59	67
GAF	600	68	70	171	37	43	28.5	3	10	na	—	—	na	—	—
General Electric	4,929	8	12	1057	6	11	21.4	19	24	8,023	3	3	13.2	52	69
Georgia Gulf	1,105	46	46	300	22	24	27.2	5	9	473	50	53	63.4	1	3
Georgia-Pacific	253	90	88	na	—	—	na	—	—	na	—	—	na	—	—
B. F. Goodrich	1,977	25	25	261	26	27	13.2	46	49	1,467	22	23	17.8	38	29
W. R. Grace	3,256	15	14	406	18	20	12.5	49	56	2,436	16	15	16.7	44	49
Great Lakes Chemical	792	61	66	202	34	45	25.5	9	13	1,097	29	48	18.4	36	36
Hercules	1,632	30	27	126	42	46	7.7	64	72	1,294	25	22	9.7	61	70

$ Millions	Chemical sales 1989	Rank 1989	Rank 1988	Chemical operating profits 1989	Rank 1989	Rank 1988	Chemical operating profit margin 1989	Rank 1989	Rank 1988	Identifiable chemical assets 1989	Rank 1989	Rank 1988	Return on chemical assets 1989	Rank 1989	Rank 1988
Hoechst Celanese	$5,658	6	6	$ 576	14	16	10.2%	57	62	na	—	—	na	—	—
Hoffmann-La Roche	500	75	76	na	—	—	na	—	—	na	—	—	na	—	—
Huntsman	1,200	42	40	na	—	—	na	—	—	na	—	—	na	—	—
IMC Fertilizer	1,222	41	44	257	27	33	21.1	20	27	$1,678	21	20	15.3%	48	57
International Flavors	870	57	57	223	32	35	25.7	8	15	684	43	36	32.6	7	27
International Minerals	640	67	53	50	60	50	7.8	63	54	673	44	28	7.4	65	64
Kerr-McGee	592	69	71	125	43	54	21.1	20	29	794	38	46	15.7	47	56
Lawter International	136	98	96	23	69	70	16.5	35	23	134	70	73	16.8	42	34
LeaRonal	157	95	95	16	74	80	10.3	56	70	88	73	76	18.3	37	55
Loctite	457	79	80	80	55	60	17.5	30	45	362	58	58	22.0	23	42
Lonza	450	80	82	na	—	—	na	—	—	na	—	—	na	—	—
Lubrizol	1,124	45	47	321	21	28	28.5	2	8	733	41	44	43.8	4	6
Lyondell Petrochemical	1,905	26	—	na	—	—	na	—	—	na	—	—	na	—	—
Merck	492	76	74	59	58	62	12.0	50	53	470	51	54	12.6	55	58
Mississippi Chemical	209	92	93	47	61	76	22.5	14	66	577	46	60	8.1	64	76
Mobil	4,039	11	10	774	9	9	19.2	28	28	2,702	12	11	28.6	10	13
Monsanto	5,782	5	5	929	8	8	16.1	36	42	4,482	7	7	20.7	28	33
Morton International	935	54	55	144	39	44	15.4	38	40	861	36	40	16.8	42	44
NL Industries	1,001	49	49	278	25	30	27.8	4	12	na	—	38	na	—	12
Nalco Chemical	1,071	48	51	181	35	42	16.9	33	43	939	32	39	19.3	33	43
National Starch	1,569	34	34	226	31	36	14.4	41	51	1,269	26	27	17.8	38	48
Nova Corp.	778	63	—	na	—	—	na	—	—	na	—	—	na	—	—
Nu-West	155	96	—	−3	79	—	def	79	—	170	67	—	def	73	—
Occidental Petroleum	5,203	7	7	1235	4	5	23.7	13	20	5,508	6	6	22.4	21	39
Olin	1,285	38	36	174	36	53	13.5	45	74	936	33	34	18.6	35	67
PPG Industries	1,175	44	42	257	27	31	21.9	16	18	1,033	31	29	24.9	13	26
Petrolite	275	89	86	19	71	74	6.7	68	73	191	65	68	9.7	61	63
Pfizer	509	74	72	39	63	65	7.7	64	69	538	49	52	7.2	66	72
Phillips Petroleum	2,449	20	19	652	11	7	26.6	7	3	1,377	23	24	47.3	3	4
Quaker Chemical	182	94	94	23	69	78	12.7	48	63	109	72	74	21.0	27	59
Quantum Chemical	2,015	24	21	423	17	13	21.0	22	5	1,830	19	21	23.1	19	5
Rhône-Poulenc	1,600	32	35	na	—	—	na	—	—	na	—	—	na	—	—
Rohm & Haas	2,661	18	18	287	23	22	10.8	54	48	2,128	17	17	13.5	51	38
Shell Oil	3,833	12	11	941	7	10	24.5	11	32	3,824	8	8	24.6	14	41
Sherex	188	93	92	na	—	—	na	—	—	na	—	—	na	—	—
Sigma-Aldrich	359	84	85	87	53	57	24.2	12	14	418	54	61	20.7	28	24
Solvay America[a]	1,000	50	50	na	—	—	na	—	—	na	—	—	na	—	—
Stepan	346	85	84	12	77	74	3.4	75	78	215	64	68	5.4	68	64
Sterling Chemical	581	70	64	156	38	24	26.9	6	1	329	59	63	47.5	2	1
Sun Co.	510	73	75	na	—	—	na	—	—	na	—	—	na	—	—
Tenneco	1,224	40	—	119	44	—	9.7	60	—	1,229	27	—	9.7	61	—
Terra Chemicals	949	53	56	na	—	—	na	—	—	na	—	—	na	—	—
Texaco	1,818	27	28	399	19	21	21.9	16	21	1,126	28	31	35.4	6	8
Union Camp	413	83	81	14	76	69	3.3	76	76	289	61	63	4.7	70	70
Union Carbide	7,962	4	4	1225	5	4	15.4	38	26	6,172	5	4	19.8	31	30
Uniroyal	805	60	62	na	—	56	na	—	58	na	—	32	na	—	74
Unocal	1,276	39	39	74	56	40	5.8	70	47	622	45	49	11.9	57	14
Vista Chemicals	779	62	59	227	30	39	29.2	1	16	567	47	51	40.1	5	7
Vulcan Materials	430	82	83	86	54	60	20.1	25	39	na	—	—	na	—	—
Witco	766	64	61	18	72	62	2.3	78	71	377	56	56	4.7	70	50

Note: Companies giving only net profits are not ranked. There are 79 firms ranked for operating profits and operating profit margin, 73 firms ranked for chemical assets, and 72 ranked for return on assets.

Montedison, which has not yet disclosed U.S. results; UGI, which has sold its industrial gas operations; and Products Research & Chemical, 1988's 100th ranked firm, which was acquired by Akzo and which probably would have dropped from the list anyway as bigger companies forced it off. The remaining company, Henkel, would not disclose U.S. sales for 1989.

As in the past, Du Pont is number one in chemical sales in the rankings followed by Dow Chemical, but the gap between the two seems to be narrowing. There is now just a little more than $1 billion separating the two companies and, since Dow has some sales that normally would be classified as chemical in a nonchemical division, the difference between the two companies may be even smaller than that.

In other rankings, Du Pont is number one in identifiable assets devoted to chemicals, having taken over that position from Dow, which was number one in 1988, but falls to second in the 1989 listing.

Dow, however, leads in the operating profits that it derives from its chemical operations, with Du Pont second. These companies held the same positions in the rankings of 1988 results.

In operating margins, both Du Pont and Dow rank far down the list. The operating profit margin (operating profits as a percentage of sales) ranking for 1989 was headed by Vista Chemicals, which was 16th in the 1988 ranking, followed by Lubrizol, which was eighth the year before. Number one in 1988, Sterling Chemical, fell to sixth, and number two, American Petrofina, dropped to 23 in 1989.

For return on chemical assets, the leader was Georgia Gulf, up from third in 1988, followed by Sterling, down from first in the 1988 ranking. Number two in 1988, American Petrofina dropped to eighth place in the latest list. □

Industry leaders bullish on biotech outlook

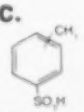
BOSTON

Prospects for success in the 1990s are arising from the groundwork laid in the 1980s by developing biotechnology companies. That's the view expressed by industry leaders at an ACS symposium reviewing and forecasting the state of commercial biotechnology. An increased flow of new products in the 1990s will propel the industry into "long-awaited prosperity," says Roger E. Shamel, president of Consulting Resources.

Although biotechnology products will not dominate the pharmaceutical market, says George B. Rathmann, chairman of Amgen in Thou-

Rütgers

Ruetgers-Nease Chemical Co., Inc.
A Subsidiary of Rutgerswerke AG of West Germany



PRESENTS:
TOLUENESULFONIC ACID
xylenesulfonic acid, cumenesulfonic acid, & blends

Sulfonic acids find their greatest utility as catalysts, especially for organic reactions. We offer TSA refined, TSA blends with methanol or water, modified TSA, and XSA refined and technical. Available in our own tankwagons or drums from Cincinnati, Ohio or State College, Pennsylvania. Ask for our Sulfonic Acid brochure.

BASIC AROMATIC CHEMICALS
ORGANIC INTERMEDIATES

Ruetgers-Nease
201 Struble Rd., State College, PA 16801
(814) 238-2424 • FAX 814-238-1567

Quality and Creativity — A Team Effort

CIRCLE 32 ON READER SERVICE CARD

NEW BROCHURE

VITRIDE® Reducing Agent
$NaAlH_2(OCH_2CH_2OCH_3)_2$

A Proven Safer, Cost Effective Reducing Agent

- Non-pyrcphoric at ambient conditions
- Soluble in a variety of solvents
- Unlimited shelf life under dry conditions
- Allows high reactor loadings
- Reduces your reduction costs

Call or write for your copy of a new economics brochure or a free sample.

HEXCEL® chemical products

215 N. Centennial, Zeeland, MI 49464 Phone (616) 772-2193 FAX (616) 772-7344

CIRCLE 14 ON READER SERVICE CARD

EPA Proposes Nationwide Recycling Program for Ozone-Depleting CFCs

Program would replace patchwork of state and local rules; chlorofluorocarbons used in auto air conditioners are likely first target

To the satisfaction of both industry and environmental groups, the Environmental Protection Agency is proposing a national recycling program to prevent emission of ozone-depleting chlorofluorocarbons (CFCs) into the atmosphere. In an advance notice of proposed rulemaking (ANPRM) signed April 23 by EPA Administrator William K. Reilly, the agency has asked for comments on the program's scope and on the mechanisms by which it would be carried out.

"EPA has already issued rules under the Montreal protocol reducing CFC production and importation 50% by 1998," Reilly said in a statement accompanying the ANPRM. "Recycling could play a significant supplementary role by reducing emissions and easing the transition to ozone-safe substitutes."

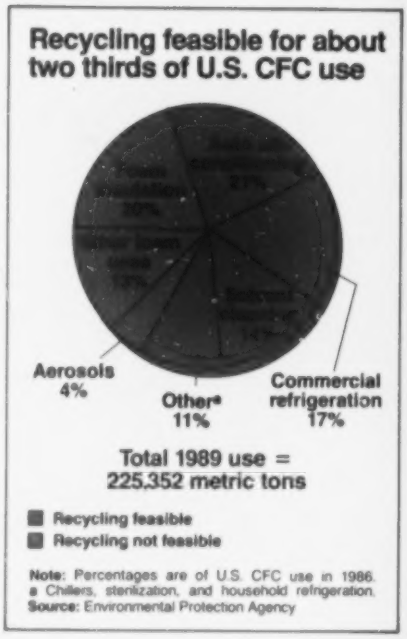
Not just a 50% reduction but a complete phaseout of fully halogenated CFCs by the turn of the century will soon be mandatory. President Bush has already committed the U.S. to that goal and the Senate's version of the Clean Air Act would make that commitment U.S. law. Moreover, the complete elimination of CFCs will become international law when the nations that are party to the Montreal Protocol on Substances That Deplete the Ozone Layer vote in June to strengthen the international treaty.

A national U.S. recycling program would have several benefits, according to EPA. It would reduce unnecessary emissions of CFCs from air conditioners and refrigerators. As the phaseout progresses, recycling would conserve the supply of CFCs for use in existing equipment that can't use alternative chemicals. And a national program would check the proliferation of state and local regulations that could result in a confusion of differing standards.

It was the advent of just such state laws that prompted the Alliance for Responsible CFC Policy, a trade group composed of companies that produce and use CFCs, to petition EPA last fall to write national regulations. "We've been anxious to get going and get a national program that will introduce some consistency at the state and local level," says Kevin J. Fay, executive director of the group. "We're pleased EPA has finally put something out."

Also pleased is Liz Cook, ozone campaign director for Friends of the Earth (FOE). Along with the Natural Resources Defense Council, another influential environmental group, FOE has been working with state legislatures on banning certain uses of CFCs and on mandatory recycling for auto air-conditioning systems. "The ANPRM is the first step toward a national program that addresses what we've been working on at the state level," she says.

As has the environmental groups' strategy, EPA's proposed program would focus first on air-conditioning equipment in motor vehicles—the largest single use of CFCs in the U.S. Thanks to a joint voluntary effort by EPA, the auto service industry, and auto manufacturers, standards of purity for recycled refrigerant in motor vehicle air conditioners already exist. Also, a number of companies already are producing equipment for recovering and recycling CFCs from auto air conditioners. Thus, recycling of CFCs while servicing auto air conditioners is technically feasible now.


Recycling feasible for about two thirds of U.S. CFC use
Aerosols 4%
Other* 11%
Commercial refrigeration 17%
Total 1989 use = 225,352 metric tons
Recycling feasible
Recycling not feasible
Note: Percentages are of U.S. CFC use in 1986.
a Chillers, sterilization, and household refrigeration.
Source: Environmental Protection Agency

EPA also is considering mandating recycling of CFCs from household refrigerators. Although that technology is not as advanced, Whirlpool has recently developed a multilayer plastic bag that its service technicians can use to capture refrigerant when they make house calls. The agency may later extend the recycling program to CFCs from chillers—air-conditioning systems in large buildings—and commercial refrigeration systems.

EPA is asking for comments on how it should carry out its recycling program. In addition to encouraging voluntary programs, the agency could mandate recycling for specific CFCs uses (direct regulation). Or it could set up a market-oriented program that would provide a financial

incentive to recycle. That is, purchasers of CFCs would have to pay a deposit that would be refunded when the chemicals were returned.

Both industry and the environmental groups are opposed to the deposit-refund approach, although for different reasons. "We would not favor market incentives," says FOE's Cook. "That allows someone who has the money to be able to pay to pollute."

"The market initiative is just another excuse for a tax," says the Alliance for Responsible CFC Policy's Fay. The alliance's members are still smarting about the ozone-depletion tax imposed on CFCs in the fiscal 1990 budget law. "We have a feeling there would be a lot more deposits than refunds."

According to EPA's ANPRM, hydrochlorofluorocarbons (HCFCs), which are among the compounds being developed to replace CFCs, might also become subject to mandatory recycling. Although HCFCs have a much shorter lifetime than fully halogenated CFCs, they do carry some chlorine into the stratosphere where it can catalyze the destruction of ozone.

HCFCs' significant, though small, ozone-depletion potentials have made them controversial compounds. Mandatory recycling may turn out to be the least stringent of the possible regulatory fates that await them. International negotiators are still arguing over whether and how they should be included in the new, tougher version of the Montreal protocol. In the U.S., the Senate's version of the Clean Air Act would ban them by 2030.

Although EPA thinks HCFCs are essential for a smooth transition away from CFCs, the agency does not want their use to grow at such a rate that total chlorine concentrations in the atmosphere remain higher than they were when the Antarctic ozone hole first appeared. "Recycling HCFCs," says EPA, "is an essential element of any program to allow for the use of HCFCs to replace CFCs."

The recycling ANPRM will be published soon in the *Federal Register*. Written comments are due 60 days after it appears.

Pamela Zurer

Firms to develop global environmental initiative

Lee M. Thomas, former Administrator of the Environmental Protection Agency, is now helping U.S. companies develop a global environmental management initiative. Thomas' Atlanta-based environmental engineering and consulting firm, Law Environmental, is actively involved in assisting 17 major U.S. firms in setting up this initiative.

According to Thomas, the initiative "is a commitment of the U.S. business community to work with the United Nations and business in other countries to share its experience, know-how, and creativity in the environmental, health, and safety area." The 17 companies are committed to developing appropriate programs, and to funding and staffing them. The participating firms are Allied-Signal, AT&T, Boeing, Dow Chemical, Duke Power, Du Pont, Florida Power & Light, IBM, ICI Americas, Merck & Co., Occidental Petroleum, Philip Morris, Procter & Gamble, Southern Co., Tenneco, Union Carbide, and USX.

The U.S. firms will contribute about $1 million over the next two years for projects yet to be worked out. Formal work plans will shortly be put together by the firms. Their aim is to develop ways of sharing vital information and management expertise with countries desperately in need of such know-how. (Initial candidate countries could include the newly emerging democracies of Eastern Europe.)

Thomas: share experience, know-how

Through the initiative, the companies hope to develop methods for gauging progress made toward environmental, safety, and health objectives, and to encourage the use of such methods. They also plan to prod trade associations and industry groups into tailoring certain of their achievements to environmental, safety, and health objectives. And finally the companies plan to communicate with the public on activities conducted as part of the initiative.

The 17 U.S. companies firmly believe this initiative should be global in scope. To that end, they will design their initiative to support and be coordinated with similar efforts under way in the UN Environment Program, the International Chamber of Commerce (Paris), and the International Environment Bureau (Geneva).

The global dimensions of the initiative are to be stressed at the UN's meeting on sustainable development at Bergen, Norway, later this month. The meeting is being held in concert with the International Chamber of Commerce's Industry Forum on the Environment, which is likely to draw European and Asian businesses into the initiative.

The ICC meeting is expected "to develop an agenda for action for the 1990s," says Susan Vogt, director of Law Environmental's Washington, D.C., office. The U.S. firms intend to participate vigorously in the creation of ICC's agenda, or global charter, for sound environmental management. The charter is expected to be ready for the 1991 World Industry Conference on Environmental Management. And the new U.S. business initiative "should dovetail well with what the ICC wants to do," Vogt adds.

The U.S. firms participating in the initiative expect their numbers to grow, but how this all evolves after the initial two years depends significantly on getting European and Asian participation, and on the outcome of the Bergen meeting.

Lois Ember